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THE GALAXIES AND TIME*

By OTTO BLÜH

LISTENERS attending lectures on astronomical and astrophysical problems in our meetings must have often been impressed by the fact of how great is the indebtedness of astronomy to physics, to its theories on the one hand, and to its instrumental modern means on the other. The problem which we want to discuss to-night is one which, on the contrary, brings into focus the importance which astronomical observations have for the formation of the basic ideas of physics, and through it for all the sciences and philosophy. In this sense it may be true to say that Plato's realm of ideas is located in the heavens.

Space and Time are the two fundamental concepts which grew out of astronomical observations. Back in the age of Greek science, an unnamed 'Pythagorean' astronomer taught the vastness of space, which became the medium of geometry and physics. The concept of time arose also in early days from the observation of the succession of events, in particular of regular motion as was observed in the night sky or in the regular motion of the sun. The apparent one-dimensional continuous flow of time was seen as the background of historical, personal and natural events; along its line followed guilt and fate, cause and effect.

RELATIVITY

Copernicus' revival of the solar system at the beginning of the modern age contained already a further element of thought, namely

*A lecture before the Vancouver Centre on April 12, 1949.

the relativity of the observer's standpoint. The great astronomer's hesitancy to declare the solar system as the only true description of the planetary world is usually explained by his wish to avoid a conflict with ecclesiastical authorities. His statement, however, that the heliocentric system and the geocentric system are of equal value, that the former has only a greater simplicity—that it is, as we would say to-day, a better working hypothesis—may have easily been his scientific opinion, and quite in agreement with the free intellectual spirit of the Renaissance. Bruno's plurality of worlds, and Descartes' multitude of vortices were suggestions about the universe in the same vein. The age of Galileo was more narrow-minded; he was himself a child of his time.

Time enters physics proper with the investigations of Galileo, the introduction of the physical term acceleration, and with Huygens' pendulum clock, then the most perfect instrument to measure 'local time'. And again an astronomical observation opens up new vistas of thought: Roemer interprets his and Cassini's observations on the moons of Jupiter as due to the finite speed of light, showing that an observation may happen to be made after the event, and that corrections have to be applied to bring the time table of the eclipses in agreement with observations.

All these experiences and this knowledge went into Newton's dicta on space and time. The scholia in his *Principia* (1686), defining absolute space and absolute time, it should be remembered, follow after the 'definitions' which he gives for momentum, force, inertia, and it may seem doubtful whether they should not be understood as of a defining character rather than as statements of his true opinions. Whether Newton considered them as no more than as 'categories', as was later done by Kant, as concepts in which we think, cannot be ascertained. The predicate 'absolute' was certainly misleading. Mach, Newton's greatest critic on just this point, admits that Newton was not feeling safe on the ground of his more general considerations, and seemed to have been glad to turn from the introductory remarks to less precarious problems.

Mach's criticism was very important for the philosophical background of Einstein's theory of relativity, in which space and time were denied any absoluteness. One of the most influential statements during this development was Minkowski's grandiloquent declaration

about a union of space-time. His purely mathematical construction was transformed by these words into a widely misunderstood statement about the true nature of space and time. H. G. Wells' "Time-Machine" had anticipated the misconception by accepting the time-ordinate as a kind of fourth ordinate of a spatial continuum, and Mr. Dunne's[1] more recent popular attempt to look into the future by travelling along the time-ordinate seems to argue similarly. And also the different approach of Alexander's philosophy[2] on matter and mind was influenced by the seemingly physical nature of Minkowski's dictum.

The Primacy of Time

That the physical quantity time, as it appears in physical equations, was only loosely connected to the immediate human experience of time and duration had been particularly stressed by Bergson, and by the schools of phenomenologists and existentialists.[3] It is from such an awareness that the astronomer Milne began to question the union of space-time, and to propose that the combination of time and space in a continuum does not mean more than a mathematical construction. He seems here to share the cautious attitude with the founder of relativity himself.

Milne observed that there is, logically, a primacy for temporal as compared with spatial measurements, and showed that a kinematics can be built up which gives priority to time measurements over those of location and length. To measure length (with standard rods) one has to define what distance means, namely the length between two points *at the same time*. Milne therefore suggests for the measurement of length the application of the now well-known 'radar'-principle, by which the time interval is measured in which an electromagnetic wave (light) reaches an object and returns, after reflection, to the location of the sender. The measurement of length is then reduced to a measurement of time, provided that the velocity of the signal is known.

To measure time alone it is only necessary to observe two events, namely the emission and the reception of the signal, at the same

[1] "The serial universe", London, 1942.

[2] "Space, Time and Deity", London, 1920.

[3] Compare H. W. Carr, "Time and history in contemporary philosophy", Oxford, 1918; Emile Borel, "Space and Time", London and Glasgow, 1926.

place, in one's own consciousness, by referring to nothing else but the empirical awareness of the passage of time. The two events can be observed reliably at the one observer's own location in his immediate consciousness. Simultaneity and succession form the complete data if the events take place at the observer's standpoint.

Events at a distance must be set in another order by a second observer in whose experience they are also subject to immediate judgment. The two orders of events, as they appear to any observer must be brought into relation, and alternative time-scales for judging the same set of events have to be introduced. But each observer judges the other's observations by means of a clock in his own location. Milne is able to deduce the Lorentz-transformations, connecting physical events in two systems in relative motion to each other, in a kinematic analysis which appeals only to our consciousness of time.[4] His kinematic relativity is in agreement with the earlier relativity theory, but it includes also new knowledge in purely physical respects, a subject outside the realm of our present discussion. As in Einstein's theory, the velocity of light is 'postulated' as a constant, but in Milne's opinion this postulate is of an *a priori* character, i.e., it is taken without recourse to the empirical result of the Michelson-Morley experiment, or De Sitter's co-ordination of observations on double stars, namely as an agreement between observers. Reversing Hegel's famous pronouncement we are, in this instance, allowed to reach the happier conclusion "All *the better* for the facts".[5]

The Red-shift and the Galaxies

In spite of the a priorism which Milne claims for his physics, his theory is based on astrophysical observations, and has been fitted to the realities of this universe, in particular to the phenomenon which, whatever its true nature, has been called 'the flight of the galaxies'.

Luminous clouds of spiral form, observed by Herschel and Rosse

[4] *Philosophy*, vol. 16, p. 356, 1941. Milne's papers have been published mostly in *Proc. Roy. Soc.* (A), since 1936.

[5] The German philosopher Hegel, in the first decades of the 19th century, had deduced *a priori* that the number of planets was seven. After the detection of Neptune, the eighth planet, he dismissed the idea this would be damaging for his philosophy, with words: 'This is too bad for the facts'.

about 200 years ago, were understood at the time of their discovery to represent the initial state of planetary systems, in accordance with Kant's and, later, Laplace's theories. Measurements at a much later date showed these spiral nebulae to be much farther away than originally believed, and therefore to be much larger objects than planetary systems. Although few of the spiral nebulae reach the size of our galaxy, the system of stars forming the milky way, in which our sun is located, the nebulae, which number a few hundred millions, can be set in analogy to our galaxy; they are galaxies. The Andromeda nebulae, e.g., which is approximately 0.7 million light years from us, has a diameter of 45,000 light years. Similar objects have been studied in detail; they show a considerable variety of forms but are all great swarms of stars.

There are other interesting objects in the sky, like the planetary nebulae, the diffuse nebulae, like that of Orion, and the dark nebulae, but none have attracted so much general attention as the extra galactic spiral nebulae or galaxies. The reason for this to to be found in the observation made about 1924 that the spectra of the spiral nebulae show a red-shift of spectral lines, which, as Hubble found, is proportional to the distances of the nebulae.

The observed red-shifts are of very great amounts; and explained as 'Doppler-effects' they indicate very high relative receding velocities between our galaxy and all the other galaxies. No other movement than recession has been found. A nebula about one million light years away recedes with a velocity of 140 miles per second, one of 135 million light years distance with a velocity of 14,000 miles per second and the speed of recession of the farthest nebula observed—500 million light years away—was found to be 25,000 miles per second. The new telescope on Mount Palomar is expected to double the limits of observation to one thousand million light years, and the observed speeds of recession according to Hubble's rule should then be found to be 50,000 miles per second, more than a quarter of the velocity of light.

If a recession of all the nebulae from a common origin is assumed, the distance-velocity law allows us to compute the time datum at which the recession of all the galaxies started. This time is around 2,000 million years, a time which coincides fairly well with the age of the earth as calculated by various scientific methods, in

particular from radioactive decay. Exception was taken to what was considered as a much too short time interval for the 'expansion of the universe', and the idea was repudiated that the planetary system had been created as early as the recession of the nebulae began, when space was filled with matter of high density. For a long time it was assumed that the planetary system was formed from a solitary sun-star through ejection of masses into the free space; perhaps under influence of another solitary star traveller. Doubts about the exactness of the figures for the age of the universe and the age of the earth have been expressed, but corrections can not change fundamentally the established coincidence. The biologist Haldane has rightly pointed out that instead of trying to explain away the similarity of values one should consider it as an important indication for the simultaneous creation of universe and planetary systems. Haldane[6] has also sugegsted in an ingenious hypothesis what the absorption of giant light quanta by a primitive sun could produce a planetary system. From this standpoint the uniqueness of our planetary system and with it of life on our planet seems doubtful.

The Expanding Universe

Immediately arising from Hubble's discovery was the question whether we have before us an actual recession of all other galaxies from our galaxy, or whether a different explanation for the observed fact was possible. The current scientific relativism excludes any assumption that the motions of the nebulae are to be considered as a true recession from our planetary system. As mentioned before, Copernicus has acknowledged that the heliocentric and the geocentric systems are two descriptions of the planetary system of which the one has the advantage of greater mathematical and geometrical simplicity. Einstein had further shown that an observer cannot decide whether he is at rest or in motion, or that all motion is relative. From such a standpoint it had to be assumed that the expansion of the universe would have to be the same for any observer on any of the nebulae. The idea that not only the laws of physics, as we know them, should be valid throughout the universe, but that the kinematic phenomena in the universe would appear to all observers the same, has been raised by Milne to a 'cosmological principle'. All

[6] *Nature*, vol. 155, p. 133, 1945.

observations should be independent of the location of the observer, no place in the universe should be outstanding in any respect, any differences being only of local importance.

The relativistic attitude was sufficiently satisfied through the theories of Lemaître and Eddington. The latter greatly contributed to the theory of the 'expanding universe', which he popularly explained with the two-dimensional model of the surface of an inflated rubber balloon. The reason for the 'expansion of space' could either be found in a formal explanation by which the radius of a closed and curved space would increase, or that an exponentially increasing disruptive force is acting in the universe. The expansion of the universe was considered to have begun very slowly, but continually increasing in speed, so that the expansion would take about one hundred times longer than stated above.

Other explanations for the red-shift of the spectral lines, (besides the Doppler effect,) were also advanced, namely that the quanta of light would lose energy on their long distance travel, either due to a scattering effect of interstellar matter, or because of the work they had to do in escaping the huge galactial masses. Any loss in energy of the light quanta would in parlance of light-wave theory mean a reduction of the frequency, or an increase in wave-length, i.e., a red-shift. Such hypotheses are however evidently of an *ad hoc* character and in need of further arbitrary assumptions, without being able to be useful in other respects.

A different approach along relativistic lines has been made by Milne by questioning the basic principles on which the earlier relativity depends. The observed red-shift, according to his cosmological principle, must be the same for any observer in the universe, as we saw, and can be explained in two ways, under the common assumption that the light-quanta do not lose any of their energy when travelling through space, in contrast to the above mentioned explanations. The quanta are unaffected by time, they are age-less, and true messengers from the most distant past—assumed to be constant in velocity, energy and frequency—and therefore most useful for establishing such changes as have occurred in matter through the epochs of the universe.

Two Worlds

Milne describes the phenomena in the following two ambiguous ways, both in agreement with facts; as two worlds which are transformable one into the other.

The one universe is static, matter is not expanding, and the nebulae distributed evenly through a curved, hyperbolic space. The radiations which we observe from a distant nebula have been sent out by atoms similar in nature to those which are used in our terrestrial experiments; but relative to our terrestrial 'clock-time' these atoms have been slower than those which we observe to-day. If a pendulum clock is used to 'time' periodicities in atoms one would find that the atoms are speeding up their vibrations through the ages.

The more distant the galaxies from us, the longer did light travel, and the more are the present atoms advanced in time assessed on the 'clock-time' scale. The quanta of light have maintained their energy, and therefore frequency, and are now received in our spectrographs in a frequency range corresponding to the smaller frequencies. For increasing distances the red-shift displaces the spectral lines in our spectrographs towards the infra-red, and so makes the light of the nebulae at least invisible to the human eye. Electromagnetic waves of cosmic origin, observed recently, may partly be due to such tremendous red-shifts. The universe is really without bounds, but for any observer a definite range of vision is set through the disappearance of light for the observer.

But then Milne changes the scene. The second universe is composed of nebulae not uniformly distributed for any observer, and the nebulae actually receding for any observer, who judges himself to be in the centre of a sphere in his 'private space'. His clocks are 'atomic clocks' assumed to vibrate invariably, and the red-shift is explained as the conventional Doppler effect. The space in which the observer finds himself is a three-dimensional Euclidean space, which is open to observation up to the distance where the velocity of recession is equal to the velocity of light.

This world picture does not make use of an expanding 'framework' of space as Lemaître's or Eddington's universe. Matter is actually receding, the nebulae disappearing over the edge of a sphere

of radius $c.t$, where c is the constant velocity of light and t the time since all galaxies separated.

The change from the one spatial arrangement of masses to the other demands a simultaneous regraduation of clocks. In this way the universe, considered to be the set of receding particles, arranged with a certain density distribution, becomes the homogeneous universe of a set of relatively stationary particles, infinite in number.

Two Time-Scales

The fundamental difference between the two pictures of the universe is that we have to use in the first picture 'clock-time', also called 'dynamic time', based on the rotation of the earth, on clocks and watches; this time-scale is called by Milne the τ-scale. In the second spatial world picture we have to use 'atomic time', also referred to as 'kinematic time' or 'cosmic time', where the rotations of atomic processes (or the radioactive decay) is serving as measure of time, and the time scale is called the t-scale.

Except by the conclusions drawn from the foregoing assumptions, there is no direct evidence that atomic clocks and pendulum clocks are gradually falling out of step. The difference between the two time-scales remains undetectable locally, as the discrepancy amounts to only 1 in 2.10^9 per year.

Events can be described through both pictures, using either time-scale, with its co-ordinated spatial arrangements of masses. The regraduation of clocks has to be made with the help of the relation between τ-values and t-values:

$$\tau = t_0 \,.\, \log\left(\frac{t}{t_0}\right) + t_0$$

when we have correspondence of both scales for $t = 0$ and $\tau = -\infty$. The equation is introduced as the integral of

$$dt/t = d\tau/t_0 \,,$$

where t_0 is the present 'time' (age, epoch) on the t-scale. The time from creation is finite or infinite according to our measurements of t or τ.

The use of two time-scales, one with a finite past and another with an infinite past, can be set in parallel with a somewhat similar

problem connected with the scale of temperature. Using the absolute scale or Kelvin degrees, we obtain at $-273°$ C. an absolute zero point. About this temperature we know that it cannot be reached (Third Law of Thermodynamics), and to express this fact it would be possible to introduce a temperature scale in which the absolute zero point would be at $-\infty$. Dalton, already in 1808, had suggested such a temperature scale, which should begin at $-\infty$, and coincide with both fixed points, the freezing point and the boiling point of water. The inaccessibility of the absolute zero temperature would then be indicated by larger and larger degree intervals towards lower temperatures. However, the thermodynamic laws become more complicated when the Dalton scale is used.

Two time-scales are also in the same relationship as two different spatial metrics, e.g., the Euclidean space and its 'distorted' image seen in a spherical couvex mirror, when all objects in the infinite Euclidean space appear to be compressed into the image space of greatest depth equal to the radius of the sphere.

Coming back to Milne's two time-scales, we observe that on the t-scale the origin of time is a finite interval away from us, on the τ-scale the origin is placed back to an infinite past $-\infty$. The regraduation which transforms the universe into something like a Newtonian world, necessitates the introduction of a 'time', of an 'age', as reckoned locally, measured from the coincidence of all galaxies. If an observer's clock is graduated in t-measure he interprets the red-shift as a Doppler effect, and attributes recession to the nebulae, finding the density of material objects increasing outwards. If his clock is regraduated to τ-measure, the nebulae are stationary and the density uniform. The nebulae are not receding at all, but since atomic frequencies were smaller at the epoch, long ago in the past, when the distant nebula emitted radiation, there is a red-shift in our reception apparatus, just as 'real' as a Doppler effect.

The transformation effected between the two time-scales influences all physical quantities, e.g., the gravitational constant varies proportional to t-time, but is constant in τ-time. The radioactive decay constant, on the other hand, is only a constant on the t-scale, but varies on the τ-scale with t. Another novelty of Milne's theory is the prediction for a steady increase of angular momentum in

t-time, of great importance for all astronomical phenomena, e.g., for the explanation of the spiral arms of the galaxies.

Separation of 'Time' and 'Space'

We observe that Milne, by maintaining a relativistic standpoint throughout, places the emphasis in his theory on the metric of time rather than on the metric of space. Mathematically both descriptions of the universum are correct, and nothing seems to be in the way to see them as two 'corresponding' features of some unrecognized or unrecognizable reality. In fact, using τ-time we are making exclusive use of the quantum hypothesis in our description of light, considering the quanta as 'frozen-in' energy; referring to the t-scale we are making use of the Doppler effect, a wave phenomenon, so that perhaps we can speak about a 'correspondence' in the sense in which it has been introduced into physics by Bohr.

However, Milne has pointed out that the τ-scale, with its origin at $-\infty$, and its stationary mass distribution, is "a concession to our Newtonian predilection." He considers it as only descriptive, and has stressed that phenomena are best studied through the t-scale. In this scale the precise value of t at the epoch studied is naturally very important.

From such a standpoint, the reality seems to mean that the galaxies expand from a centre at which a catastrophic explosion, a 'creation' took place, in matter consisting originally of neutrons closely packed together in one solid mass at high density and temperature. It is a question of further consideration in the field of nuclear physics to understand the conditions under which the explosion occurred, and to give a description of the successive stages through which matter and radiation passed in the first intervals of time, e.g., the formation of the chemical elements, and the formation of stars and planets.

Milne's theory seems in its philosophical aspects still to be a strange mixture of positivism and apriorism. The best interpretation attempted to date has been given by Martin Johnson in his excellent little book "Time, Knowledge, and the Nebulae". Professor Milne has just published a book himself,[7] but we must expect that similarly to the development after Einstein's relativity theory, it may take

[7] "Kinematic Relativity", Cambridge University Press, 1949.

many years to thoroughly understand the new ideas—or at least to reconcile ourselves to them. There is hardly any doubt that Milne's theory—whatever its philosophical background—will have a profound effect on astronomy and physics, and will contribute to the explanation and understanding of many scientific phenomena, including some of the biological past.[8]

In the course of Milne's considerations the union of space and time has been somewhat shattered. From now on they are again separated, and appear as distinct concepts, and so the divorcees may be free to look for new partners; Time will perhaps follow Eternity, and Space, who can tell, may try once more to embrace its old friend, a rejuvenated material ether.

University of British Columbia,
Vancouver, B.C.

[8]Haldane, *Nature*, vol. 153, p. 555, 1944.

THE PERPETUAL WORLD CALENDAR THAT WE NEED*

By Conrad M. Morin

IT is a pleasurable honour to speak before the members and the friends of this active and deserving Centre of the Royal Astronomical Society of Canada and, in so doing, on a subject which is of such interest to them. It may, therefore, be said that we are in a perfect community of . . . sentiment! For if, for my part, I hold in high esteem this admirable Quebec section (to which belongs, I am very happy to say, one of my former pupils of the academic course, and not the least outstanding to be sure), for your part (witness "the historical" form of 4 December, 1948, on the calendar reform) you will feel drawn to the kind creature I am going to talk about: the Calendar, called universal or world, more precisely, according to its official English appelation, The World Calendar. But, beforehand, I believe it would be opportune to give some clarification.

I—Introductory Clarification

There is nothing surprising in the fact that astronomers should be interested in the calendar reform: our present calendar, in its civil part, is based on the solar year. But, the fact that a monk, who is far from being an expert in astronomy, should take it upon himself to deal with the matter, may well surprise certain minds, perhaps. Their surprise, if any, will be of short duration if they stop to think that a religious official does not for all that cease being a citizen. And, the matter of reform of the civil calendar should not be a subject of indifference to citizens, whoever they may be.

I would even say that, if any citizens should be interested in the reform of our calendar, it would indeed be the members of the clergy. Is it not, really, within the limits of the civil calendar that the liturgical calendar is developed, in such a way that any modification

*Text of a lecture given before the members of the Quebec Centre of the Royal Astronomical Society of Canada on Saturday, 26 March 1949, at Laval University of Quebec. It was printed in the *Journal of Calendar Reform* (Second Quarter, 1949) which generously allows it to be reprinted here.

Father Morin, O.F.M., is Professor of Church History at the Institute of History of the University of Montreal.—Editorial note.

in the former always affects the latter? I must admit, however, that it is not with this double purpose, but with that of the historian that I have been led to study the question. It was for the use of our students in history, as a matter of fact, in the course of technical chronology which I gave at Rome, at the St. Anthony's Pontifical University, from 1942 to 1945, that I had to expose the various computations of time used in the past. At that time I became aware, among the reforms concerning the Gregorian calendar, of the plan of The World Calendar Association. Then I studied this plan thoroughly, and I was able to admire its simplicity, its logic, the facility of adoption and its beneficial usefulness. Moreover, I could not help working to make it better known. That is all!

However, the question may at least arise, is it not strange that a man of the Church, a professor of a Catholic university, should become the protagonist of a plan intended to supplant the Christian calendar? This objection, let us hasten to say, is not one in reality.

First of all, the present calendar is not Christian, either by its nature or by its origin; its author was, in the year 45 B.C., a pagan, Julius Caesar (whence its name of the "Julian calendar," until the XVIth century), and its names of months and of days, excepting those of Saturday and Sunday in the Latin languages alone, are secular names. It is Christian merely because the Church has adopted it from time immemorial and integrated with it its liturgical calendar (which is lunar, as it is known), and reformed it in 1582 under Pope Gregory XIII (whence its name of "Gregorian calendar") to make it synchronize with the astronomical year.

Moreover, even if it were really Christian it would be none the less modifiable, for it is not an institution which is essential to the Church. In other words, it does not pertain to divine law, even insofar as concerns the continuity of the week of seven days. This aspect was explicitly recognized by the Holy See, when, by letter from the Apostolic Nuncio at Bern to the Secretary General of the League of Nations, under date of 7 March, 1924, it was declared that the reform of the Gregorian calendar "did not create any dogmatic difficulty."[1] Thirteen years later, in July 1937, the Holy See expressed itself likewise, when it wrote in a *Memorandum* to the principal States of the League of Nations, shortly before the assembly which the latter was to hold in September on the reform of the

calendar: "The proposed modifications are not in contradiction with any dogmatical truth."[2]

However, if the reform of the present calendar does not involve the faith, it is none the less true that it runs up against an old and strong tradition of Christianity, and, hence, of a good portion of humanity. Besides, that it should not be taken lightly is obvious. It could only be justified by "motives of universal interest," the representative of the Holy See added in his letter to the Secretary General of the League of Nations, on 7 March, 1924;[3] a point of view which was confirmed practically in the *Memorandum* of the Vatican of 1937, above-mentioned, which declares, in particular as regards the interruption of hebdomadal cycle, that this could not be done with good reason "without a quite clear and very serious motive."[4]

Hence, to-day, if I am not mistaken, serious motives are not lacking to militate in favour of the reform. Among these motives, it will be agreed that the strongest are not those of a material order, but those of a spiritual order. It is natural that a member of the clergy would devote himself in particular to these latter. For my part, I consider that any project which does not run counter to the law of God nor to the interest of the Church, and is of a nature to favour peace and unity among men, deserves to be encouraged and that one should assume the propagation thereof. And, in so saying, I do not believe that I am in conflict with the ideas of the Sovereign Pontiff gloriously reigning, far be it! Did he not say in his Christmas radio message, on 24 December last: "The fidelity of the Catholic Christian to the divine inheritance of truth left by Christ to the magisterium of the Church does not in any manner condemn him—as is believed by many people, or which they affect to believe—to a defiant reserve or a cold indifference in the face of urgent and serious duties of the present time. On the contrary, . . . everything proclaims the *obligation of the faithful to engage,* according to their means and their possibilities, *in the matters which have to be solved by a tried and troubled world.*"

II—The Origin of The World Calendar

Some may be inclined to believe that the project of The World Calendar Association was engendered by prejudice, that is by the desire to supplant, in an *anti-Christian* spirit, the calendar deriving

from the reform of Gregory XIII, in 1582, and replace it by a *secular* calendar. The truth is quite the contrary. The author of this initiative was a Catholic priest of Italy, the Abbé Marco Mastrofini, mathematician and philosopher. His purpose was not to put aside the Gregorian calendar, but *to perfect* it by fixing the weeks, in such a manner that the civil year would have 52 complete weeks or 364 days only and always start on a Sunday. To this end, he would make a special case of the 365th and 366th days of the astronomical year by giving them respectively the names of *feria octava* (eighth day) and *intercalary* day, without however equalizing the quarters or giving a fixed date to the feast of Easter. Such was the project which he exposed in a publication of 316 pages, containing three *Nihil obstat* and two *Imprimatur* and entitled *Amplissimi frutti da racogliersi ancora sul calendario gregoriano,* which may be translated as follows: "very ample fruits to be drawn still from the Gregorian calendar." This was in 1834.

It was left to a French astronomer, Camille Flammarion, to draw the attention of the great public to this project, fifty years later. In 1884, he launched in his review *L'Astronomie* a competition on the reform of the civil calendar. The six best projects of the fifty presented received a prize and the report of them which was published, in 1887, brought two important improvements to the effort of the Abbé Mastrofini: *symmetry* of the quarters, in view of the fact that they each contained 91 days or 13 complete weeks, and the fixing of the beginning of the year at the winter solstice.[5] In short, the idea of the reform of the calendar in the sense of invariability, symmetry and universality made so much progress that, as from 1900 in particular, it became a matter of public and international concern. Scholars and businessmen entered it on the agenda of their international congresses; the International Chamber of Commerce required, first in 1910 and later in 1921, that an international conference be held to settle the question; a large number of drafts of all kinds were proposed, but the International Astronomical Union fortunately brought some order to the situation, in 1922, at its Congress of Rome, when its calendar commission, which was established in 1919, asked for the adoption of a perpetual calendar which maintains "the 52 weeks divided into four quarters of 91 days, plus one

or two extra days, depending upon whether the year is common or bissextile."[6]

In the meantime, the League of Nations had just come into existence. It was therefore approached with the question. Its Advisory Commission for Communications and Transit then formed, in 1922, a Committee to study the calendar reform which was to be based on the above mentioned decisions of the Congress of the International Astronomical Union and that of the International Chamber of Commerce. In 1926, this Committee therefore eliminated many drafts which did not comprise the two following combinations: year of 12 months with a total of 364 days divided into four equal quarters, and a year of 13 months of 28 days, with the necessary supplements to make one and the other conform to the astronomical year. Propaganda in favour of the reform was then intensified, especially in South America and in the United States.

Thereupon, to preserve the perpetual calendar of 12 months against that of 13 months—which the International Fixed Calendar League, founded in Rochester in 1924, and the National Committee on Calendar Simplification, founded in 1928, were endeavoring to have supersede it—on 21 October, 1930, The World Calendar Association was founded in New York. Under the able and indefatigable Miss Achelis, founder and first president who is still so admirably active, such good work was done in organization and propaganda (among other things, the foundation of the *Journal of Calendar Reform*) that the Association succeeded in obtaining a hearing at the meeting, in June 1931, of the Preparatory Commission of the Organization of Communications and Transit and was invited to participate officially in the International Conference of the same organization, the following October. What is more, The World Calendar Association succeeded so well in winning over other associations of the kind to its cause that it prevented the 13-month plan from taking the first place and even survived it, since, at the meeting of the Council of the League of Nations, in January 1937, the matter of the plan of 13 months did not even arise: it was merely a matter of knowing whether or not it would be decided to call an international convention for the adoption of the calendar of The World Calendar Association. What was it that thus gave it such a privilege? Its merits no doubt.

III—The Merits of The World Calendar

Therefore, far from supplanting the Gregorian calendar, the plan of The World Calendar Association does not even reform it really: it is just a *perfection* of it. In other words, it only corrects the troublesome defects: irregularity and variability, the source of much hardship, of loss of time and of money, and even of breaches in matters of religion. To eliminate the cause of this irregularity and this variability, that is, the overlapping of the week of one month on the dates of the other and, what is worse, of one week in one year on the beginning of the next, all that had to be done was to make a special case, in the civil calendar, of the annual *astronomical* 365th day and of the bissextile 366th; in such a way that the civil year consists of 364 days or 52 complete weeks, that is, four quarters absolutely equal of 13 complete weeks or 91 days divided into invariable months of 31, 30 and 30 days.

The special days, however, are not "blank" days. They count in life, since they form part of the *astronomical* year, which no human being is in a position to change! On the other hand, they cannot count *numerically* in the run of the *civil* calendar, excepting at the expense of its regularity and invariability. That is why, from a *civil* point of view, they are considered as *intercalary* days, *supplements* to the series in termination. And to mark this peculiarity clearly, as well as to avoid breaking the *numerical symmetry* of the quarters, they are not given the name of a weekday, but a special appellation; "Yearend Day," or "Worldsday" for the 365th day, and "Bissextile Day" for the 366th; then they are placed between the part terminating and the part following, that is for the former, between the 30th of December and the 1st of January, and for the latter, at the end of the semester of the current year, between the 30th of June and the 1st of July. Moreover, to be logical, they are not dated by figures, but by letters and according to the name of the preceding month and the date of the current year. These letters are merely *"W"* and *"M"* because these are the first letter of the word "world" in the five principal modern languages (*monde, mundo, mondo, welt, world*) as well as in the Latin language (*mundus*). Thus, to date the yearend day of 1950, one would write: W December 1950 or M December 1950. In leap years, for the bissextile day, likewise one would say: W June or M June.

Thanks to the perfect symmetry thus obtained, each quarter like each year begins with a Sunday and ends with a Saturday, without changing the numerical series of the following year. And, since the intercalary days *W* or *M* are world holidays, the following week would never have more than six working days. It is certainly a genial as well as a humanitarian idea of The World Calendar Association to make workers' holidays of these two extra days. Thereby, it not only respects the law of the weekly rest in honour of the Lord, but allows the occasion for *civic* days devoted to thanksgiving as well as to the concord and unity of the large family of nations. This is, to my mind, the greatest merit of this project and the glaring proof that it is far from anti-religious, or even anti-Christian; for Sunday holds the place of honour and all religions, Christian or not, can make of these two world holidays days of religious intent without in any way disturbing civil life.

Furthermore, since about 1937, The World Calendar Association's policy has been to confine itself to the *strictly civil* domain in the project which it wants to have adopted by all the States of the world. It is for this reason that it does not claim for its part the stability of the feast of Easter: it leaves the decision of this question to the religious authorities, in view of the fact that by its nature it falls within the ecclesiastical domain and is independent of the fixity of the civil calendar. In this regard, it may be noted, even if all States adopted the universal calendar, the Church would not be obliged to relinquish the mobility of the feast of Easter: it might continue to adhere strictly to the law of the Nicene Council of the year 325, that is to say, leaving this feast fixed at the Sunday that follows the full moon of the vernal equinox, with the advantage, however, of no longer having it spread over 35 various dates between 21 March and 26 April, but only over 5 of these, namely: 24 March, and 1, 8, 15, and 22 April. On the other hand, in an article appearing in the review *Culture*,[7] with which The World Calendar Association favoured you by its extract issue, and in the English translation which appeared in the *Journal of Calendar Reform*,[8] I already had occasion to demonstrate that even if it were fixed at an invariable Sunday, the feast of Easter would remain none the less the fundamental date of the ecclesiastical year and close to the spring equinox and even to the *chronological* anniversary of the Resurrection of

Christ, with no other modification of its cycle than the great advantage of invariability.

I would never come to an end, if I had to enumerate all the advantages, religious as well as secular, which could result from the universal adoption of The World Calendar. There is no need to do so, however, since you are certainly acquainted with them, and there are plenty of publications which make them more or less evident. It is sufficient to add that the plan of The World Calendar Association, besides its admirable simplicity and logic, its most worthy spirit and its perfect symmetry which makes it so easy to remember, has the tremendous advantage of presenting the possibility of immediate adoption, without in any way disturbing our daily life, and that it may start with the Jubilee Year 1950.

The 1st of January 1950, indeed, falls on a Sunday. The World Calendar, if it is approved in this year 1949, could go into effect as of that date, without its being noticeable. Otherwise as the last quarter of 1950 of our present calendar coincides with The World Calendar, it would only have to be decreed that 31 December, 1950, would be *W* December, 1950, that is, the Worldsday or the Yearend Day. Consequently, the following day would be Sunday, 1 January, 1951 (instead of Monday), and the new calendar would begin at the very completion of the Jubilee Year, in such a way that the latter, at the full half of the century, would at once end one era and commence another. The World Calendar could not start with more glamour nor by favour of a more significant event! Has it any chance of being born under such happy auspices? That remains to be seen before finishing.

IV—Will The World Calendar Be Adopted?

If it depended on the popular vote, the adoption of The World Calendar would be something quickly decided. The World Calendar Association, thanks to affiliated and connected committees, is ramified over five continents, in more than 30 countries, one of which is Canada (head office at Ottawa, under chairmanship of Mr. A. J. Hills, Royal Bank Chambers, Room 311). It has already received and continues to receive incessantly the adherence of diverse personalities and associations of the learned world (among them several astronomical societies, notably the Royal Astronomical Society of

Canada)—political, commercial, industrial, professional, educational, labour and religious. In summary, it would not be exaggerating to say, I believe, that the adversaries of The World Calendar in the civil world represent a small minority. Does the same apply to political authorities?

In January 1937, as is known, the Chilean delegate, at the request of the International Labour Conference, submitted to the Council of the League of Nations an international draft Convention for the adoption of The World Calendar. The Committee of Communications and Transit was then appointed to sound out the various States on the question, in order to receive their replies before the following 1 August. Of the 45 governments which answered, 14 only declared themselves in favour of The World Calendar. These were Afghanistan, Brazil, Chile, China, Estonia, Greece, Hungary, Mexico, Norway, Panama, Peru, Spain, Turkey and Uruguay. However, it was a significant fact that only 6 nations rejected the project positively. Just the same, because of the too wide diversity of opinion, the Council, at its 98th session, in September 1937, decided to withdraw the question from its agenda and to postpone its examination to a more propitious time.

Since then, the project of The World Calendar Association has gained ground in the diplomatic field. Three other nations have adhered to this reform: Saudi Arabia, Syria and Czechoslovakia. Even the United States of America has taken a progressive step by a bill designed to assure the adoption of The World Calendar in all the territory of the great Republic for the 1st of January 1950, which was introduced to the House of Representatives and to the Senate, respectively, on 15 July and 1 August, 1946; and later had a second reading, at the same places, on 27 January, and 26 July, 1947, at the 1st session of the 80th Congress. It was a distinct step toward general adoption.

For its part, England, through a statement of its Government made in the Parliament on 27 February, 1947, promised to give the matter "the most serious consideration," if it were submitted to the Economic and Social Council of the United Nations. In spite of all, on 24 March, 1947, the latter, at the 29th meeting of its 4th session, carefully examined the request of the Peruvian delegate to form a Committee whose mission it would be to study the possibility of

adoption of The World Calendar for 1 January, 1950, and, upon receipt of a favourable reply from the latter, to make the consequent recommendations to the General Assembly at its next session. However, the Council was content to refer the matter to its 5th ssesion, not without advising the Secretary-General, nevertheless, to assemble in the meantime all possible data on the question and to transmit the proposal of the Peruvian delegate to the Member Governments of the United Nations.

Unfortunately, the 5th session of the Economic and Social Council of the United Nations caused a great disappointment. At the last minute, the question of the calendar was crossed off its agenda. As a matter of consolation, however, this was but the result of a provision of a general order and of unfavourable circumstances. The measure undertaken had at least served to bring The World Calendar to the *official* attention of a greater number of nations. What is more, although the Secretariat of the United Nations received projects other than that of The World Calendar Association, and even protests against the calendar of the latter, it is apparent from the report of the Secretary-General[9] that petitions in favour of the plan concerned were innumerable, and that none of the Governments showed any opposition to the project; on the contrary, the majority seemed favourable to it.

However it may be, The World Calendar Association did not consider itself beaten. It succeeded in having the question entered in the agenda of the IXth International Conference of American States which was to be held at Bogota, on 30 March, 1948. To promote the success of this matter, the untiring Miss Achelis undertook a tour in South America. Unfortunately, the political troubles in Central America did not allow the President of The World Calendar Association to visit this district, nor did the Conference of Bogota deal on the matter because of the disturbing conditions that had developed. She found time, even so, to pass through ten countries of South America and to meet not only the presidents and members of various national calendar committees, but also the Ministers of Foreign Affairs. Thus, the trip gave her the most encouraging hopes.[10]

Also, thereafter, the Association did not hesitate to provide for the necessary aid to work with its various affiliated associations and

national committees of Latin America in presenting a united and solid front in view of the Inter-American Economic Conference, which was to take place in the beginning of the present month, at Buenos Aires, in Argentina, but which was postponed to the latter part of the year.[11] This consisted in having the said Conference pass a resolution "approving and recommending the adoption of The World Calendar" in order that it might "be made effective on 31 December, 1950, and thereafter, the latter date being changed to the yearend World Holiday, called Worldsday, *W* (*M* in French) December, which ends the first half of the 20th century, whereas the second half begins on a Sunday, 1 January, 1951," The resolution added: "That all nations be advised of this act and requested to co-operate in the general adoption of The World Calendar."[12]

So much for the chances of The World Calendar in the political world. Has it as much of a chance in the religious world? Among the non-Catholic religions, there is little opposition except from the Jews and the Adventists. The Protestants and the Orthodox, in general, are in agreement with the proposed reform. As for the Moslems, they seem to manifest no opposition.

Now as to the Catholic Church. Is it in favor of it or not? We have seen, in the foregoing, that it finds no dogmatic objection. In the case in point, it is simply a disciplinarian and human question. But, since a long and strong Christian tradition is at stake, the Holy See already declared that it should not be sought after without proportionate reasons. In 1937, the Vatican did not find these warranted. Moreover, it took the stand before the principal States of the League of Nations of preventing the draft from being adopted.

Since then, however, things have changed. At that time, it was fearing, I think, that The World Calendar Association did not consider the two intercalary days as non-working days. In that case, then, the *divine* law of weekly rest would have been threatened. But to-day, it is clear that the yearend world holiday (the W December or M December = Worldsday) and the bissextile world holiday (W June or M June = Leapyear Day), far from infringing upon this law, give it more force, in view of the fact that they may be devoted to God, to prayer and to thanksgiving, as well as to world unity, to joy and to peace.

Another reason why the Holy See was previously opposed to the

adoption of The World Calendar was the fear that it would necessarily entail the abandonment of the paschal law of the Council of Nicea and, thence, further divisions in Christianity. We have seen that there is no cause to entertain such a fear owing to the fact that The World Calendar Association does not propose the stability of the feast of Easter and that the fixity of the civil calendar does not necessarily entail the abandonment of the law of Nicea. Besides, this law of the Council of Nicea, as I have had occasion to write elsewhere,[13] was above all a law of uniformity rather than of accordance with the lunar calendar. The adoption of The World Calendar would, on the contrary, constitute the means of attaining even greater uniformity than at the Council of Nicea, since nearly all the Christian non-Catholic denominations are in agreement on such an adoption and even for the fixing of the feast of Easter, at the second Sunday of April (8 April).

What will the Church do if the United Nations accepts the proposed calendar? It is not up to us to dictate to it the line of conduct to be followed. It seems that a proportionate reason will be found therein to accept the reform of the *civil* calendar and even to effect that of the *liturgical* calendar. Pius XI, however, declared, in 1937, that the supreme authority of the Church would not dare go against decisions of past councils on this subject "without having first obtained the favourable vote of a new oecumenical Council."[14] For that purpose, however, it is not necessary for the Sovereign Pontiff to assemble all the bishops at Rome; they could be consulted by correspondence, as was done for the question of the Immaculate Conception and as is being done at present for the definability of the Assumption of the Virgin Mary.

However it may be, we are content to know that the Holy See is not absolutely opposed to the adoption of The World Calendar, but only "for the moment" (that is to say, in 1937), according to its *Memorandum* of 1937, more precisely and textually: *allo stato presente delle cose*. Besides, the mere fact that it consents to study the question in Council is significant now. As to the present Pope, gloriously reigning, I am not aware that he has manifested any opposition to the project. At least, the report which was presented by the Secretary-General of the United Nations to the Economic and Social Council, on 14 July, 1947, when the question was again under

discussion, does not mention any statement of the Holy See in this connection.

I am not aware either that the Church has ever forbidden the members of the clergy to speak in favour of The World Calendar. Also, the more the latter is known, the more it meets with favour among the ecclesiastics, as among practising Catholics. For my part, if I have made an error, I am ready to submit to the verdict of the Supreme Ecclesiastical Authority. That is why I paid the tribute of my above-mentioned article not only to a fair number of Canadian bishops, but also to high officials of the Roman Curia and even to its Secretariat of State, and I have received no reproach. It goes without saying that I do not intend thereby to engage the responsibility of the Holy See. At least, the fact is worth mentioning.

On this account, I did not hesitate to accept the kind invitation made to me to come and speak to you about the project of reform. I consider sincerely that it is the best of all those which have been presented, because it is among all the one that brings a real improvement with a minimum of changes; that which, on the whole, is best designed to conciliate tradition and progress. For, in the desired reform, it is not a matter of obtaining the *ideal* calendar but that which is the most *practical,* that is to say the one which remedies the depreciatory disadvantages of the present one without disturbing our religious or civil life. The project of The World Calendar Association responds perfectly to these demands; conceived in such a manner that it may be adapted to any race, country or religion, it would certainly prove for our modern world, so enervated, to be an element of order, stability, concord, unity, and even of religiousness. When the nations agree on the subject, it will be an event of good omen and one which will have constituted, furthermore, the most vast agreement ever passed among the civil and religious authorities of the world. It is therefore worthwhile to hasten the birth of The World Calendar of The World Calendar Association. May the Jubilee Year 1950 bring us this gift!

REFERENCES

[1]Letter from Mgr. Maglione to Sir E. Drummond, in the *Report relative to the Reform of the Calendar,* published by the section of Communications and Transit of the League of Nations, Geneva 1926, p. 86.

[2]"Le modificazioni proposte al calendario vigente, pur non essendo in contradizione ad alcuna verità dommatica. . . ." According to the Italian text sent by the Vatican to the Member Nations of the League of Nations.

[3]Letter of Mgr. Maglione, Nuncio at Bern, according to the *Report relative to the Reform of the Calendar, Geneva 1926, p. 86.*

[4]"Senza un motivo ben chiaro e gravissimo." According to the text above.

[5]See *Bulletin* of the Astronomical Society of France, Vol. 1, p. 62, Paris, 1887.

[6]See *Transactions of the International Astronomical Union.* London, Vol. 1, p. 188.

[7]*L'année jubilaire 1950 sera-t-elle l'ère d'un nouveau calendrier civil et ecclésiastique?* In *Culture* 8 (Quebec 1947) 381-384; in separate issue of The World Calendar Association, N.Y. pp. 5-8.

[8]*Will the Jubilee Year 1950 Open the Era of a New Civil and Religious Calendar?*, in the *Journal of Calendar Reform* 18 (New York 1948) 20-23.

[9]*The World Calendar, Note by the Secretary-General,* in *Journal of Calendar Reform,* Vol. 18, pp. 43-60, 1948.

[10]See Miss Achelis, *I Visit Ten South American Countries,* in *Journal of Calendar Reform,* Vol. 18, pp. 43-60, 1948.

[11]*Intense Program in Latin America to Ensure Action at Economic Conference,* in *Journal of Calendar Reform,* Vol. 18, pp. 147-148, 1948.

[12]*Draft Resolution, First Inter-American Economic Conference, Buenos Aires, Argentina,* in *Journal of Calendar Reform,* loc. cit., p. 149.

[13]*L'année jubilaire 1950 sera-t-il l'ère d'un nouveau calendrier civil et ecclésiastique?* in *Culture,* Vol. 8, p. 401, 1947; extract issue, p. 25.

[14]"La Suprema Autoritá difficilmente riterrebbe opportuno annullare i voti di tante solennissime e venerande Assemblee, senza aver prima avuto il voto favorevole di un nuovo Concilio ecumenico." Extract from the *Memorandum* of the Vatican to the principal States of the League of Nations, in July 1937.

OUT OF OLD BOOKS

By Helen Sawyer Hogg

Jean Sylvain Bailly, The Guillotined Astronomer

(Continued from May-June Journal)

SOME years after their first meeting, Bailly and Benjamin Franklin were both appointed to a commission to investigate animal magnetism, or mesmerism, which at that time was causing a furore in France. Mesmer had left France a second time at the end of 1781, leaving behind him some ardent disciples whose conduct at last instigated the government to appoint an investigating commission. Four doctors of the Faculty of Paris were joined in this committee by five members of the Academy of Sciences, among them Lavoisier, Franklin, and Bailly, with the latter as reporter. Bailly's report occupied several years of time. As Arago says, "Nothing equals the credulity of men in whatever touches their health. This aphorism is an eternal truth." Many interesting and rather sensational exhibitions of magnetism were investigated. Bailly remarked, "Animal magnetism may exist without being useful, but it cannot be useful if it does not exist." According to Arago, the commission established, finally and experimentally, that "the action of the imagination can both occasion the crises to cease, and can engender their occurrence."

From this work, Bailly appears soon to have turned his attention to a report on the Paris hospitals. The description of conditions at that time in the famous Hôtel Dieu taxes present-day imagination. There was little segregation of patients with different diseases, and great overcrowding. New arrivals at the hospital were laid in the same sheets from which deceased patients had just been removed. Two madmen were confined in the same bed. In the men's small-pox ward, six men or eight children were laid in one bed a metre-and-a-half wide. Normally the beds contained only four patients, placed alternately head to foot! Each had for his share of space nine inches, and had to lie on his side. The operations of that time were of course performed without anaesthetic—but in the pre-

sence of the next victims! Certainly there were many reforms for a group of scientists to institute in the hospital. Apparently the investigation with its report did help to improve conditions, and as one result, each patient was given a bed to himself.

Next, Bailly worked, again as the reporter, on a commission with Coulomb, Lavoisier, and LaPlace, among others, to investigate the slaughter-house conditions. The descriptions of the hospitals are mild compared with those of the conditions around the slaughter houses, some of which were located near the centre of the crowded capital. The cattle, driven in droves down crowded streets, escaped with resulting damage and confusion. The by-products of the slaughter were carried away by open gutters. The immediate neighbourhood of a slaughter house must have been unbearable. The reform suggested by the commission appears obvious and reasonable. Bailly wrote, "We ask that the shambles be removed to a distance from the interior of Paris." Actually it took fifteen years before this logical suggestion was carried out. Referring to this delay, Arago says, "Unfortunately there was nothing exceptional in this; he who sows a thought in a field rank with prejudices, with private interests, and with routine, must never expect an early harvest." Though it was the conditions of the eighteenth century which prompted Arago to make this comment, it applies equally well to the reforms of any century!

In November 1787 Bailly married a widow who was an intimate friend of his mother, though his own age. Madame Bailly adored her husband, and lavished every attention on him. She felt that her duty was to remain at home, while her husband's was to appear in public. Consequently only once as wife of the Mayor of Paris did she appear at a public ceremony.

A minor and amusing incident in Bailly's life at this time seems to give his biography a timeless flavour—it could happen here and now! He wrote anonymously a biography of Gresset, the French poet. One copy had been sent to the Marchioness of Créqui, a lady in high society. Some days after, Bailly called upon her, possibly hoping to hear her speak in praise of the new work. To the contrary, the lady condemned the eulogium in no uncertain terms. Though Bailly tried to change the subject, the Marchioness insisted that he see for himself how poorly the pamphlet was written, and begged

him to read some of it aloud, interrupting him with derogatory remarks. The harrowing situation continued until the arrival of another guest.

The denouement of the situation, however, came two years later when Bailly was Mayor of Paris. At this time some booksellers collected all his smaller works and published them. Much to Bailly's amusement, the Marchioness, who had by this time forgotten the incident, overwhelmed Bailly with compliments on this very work which she had previously condemned. A partial explanation of this seemingly two-faced behaviour is that the early pages of the pamphlet were somewhat obscure, but that later on the writing becomes more lucid.

In the last four years of Bailly's life, from April 21, 1789, when he was elected a deputy to the Third Estate, until November 11, 1793, when he met his death stoically on the guillotine, are crowded the events which have overshadowed his earlier reputation as scientist and man of letters. The record of part of these events is left to us in the words of Bailly himself, a set of three volumes in the series, *Mémoires sur la Révolution française,* entitled *Mémoires d'un Témoin de la Révolution, ou Journal des faits qui se sont passés sous ses yeux, et qui ont préparé et fixé la constitution française.* Some historical opinion (F. M. Fling, Univ. of Nebraska Studies, vol. 3, pp. 331-353, 1903), indicates that Bailly himself wrote the first two volumes of the famous *Mémoires d'un Témoin,* but that the third volume was written by someone else from Bailly's notes. These *Mémoires* are a long and detailed, day by day account, of the happenings of that important epoch in French history. There is evidence that Bailly worked at their composition as rapidly as possible, but that he never had time to finish them. At any rate, the *Mémoires* are given only to October 1789.

From the time of his first election as deputy, throughout his term in public life, the conduct of Bailly set a very high standard. As Fling says, (*op. cit.,* p. 340),

> It is clear that in 1789 Jean-Sylvain Bailly was one of the most distinguished of the conservative burgesses of Paris. It may well be believed that when the King learned of his election as the first deputy of the Third Estate from Paris he remarked, "J'en suis bien aise, c'est un honnête homme." (*Mém.,* Vol. I, p. 71).

Bailly's election as deputy was apparently a surprise to him, and in telling of it he stresses that he certainly furnishes an example that a man can arrive at the top with the highest honours without intrigue. This should be said, says Bailly, for the consolation of honest people, and to encourage youth to follow the right path. (*Mém.*, vol. 1, p. 9):

Enfin les districts furent formés et ouverts sur la convocation du roi, le 21 avril 1789. J'habitais alors ma maison de Chaillot, où je terminais quelques réparations et dispositions intérieures; je me rendis aux Feuillans, en me promenant, avant huit heures du matin. Assis pour me reposer sur la terrasse des Feuillans, un jeune homme, que je ne connaissais pas, passa, et me dit: "Vous allez au district des Feuillans, vous y serez nommé électeur." Je le remerciai de cette opinion et n'y comptai pas plus. Je raconte ces bagatelles parce qu'elles servent à prouver que les circonstances m'ont porté ou j'ai été élevé, et que je n'y ai contribué en rien. Nul homme à Paris ne peut dire que je lui aie demandé ou fait demander son suffrage, pas même que j'aie témoigné aucun désir des places où je suis parvenu. Je suis un exemple bien sûr qu'on peut parvenir à tout et aux premiers honneurs sans intrigue. Ceci doit être dit pour la consolation des honnêtes gens, et pour l'encouragement de la jeunesse à suivre le droit chemin.

A few days after his election as deputy, Bailly was named Secretary of the Assembly. Thus in the beginning it was he who drew up the famous proces-verbal of the meetings of the electors of Paris, the records so often used by historians.

On Tuesday May 12 the general assembly of electors voted for the nomination of first deputy of Paris, and Bailly was chosen, though not by a wide margin, since he received 173 votes out of 317, only 14 more than needed for a majority. In his *Mémoires* he comments, "I observed in the Assembly of the Electors a great dislike for literary men, and for the academicians." How true in any century!

Bailly had spoken only once (on the question of voting by being seated or standing) when, on June 3, he was named Senior of the Deputies of Communes. It was at this time that the Dauphin was critically ill; he died on the fourth of June. Bailly had been requested by the Communes to seek an audience with the King, and much misrepresentation has been made of him as being heartless to intrude on the King at such a time. The truth is that Bailly pressed for the interview only as far as his position demanded, and Louis

understood this perfectly, vindicating Bailly in a note. After the death of the Dauphin, Bailly and other members formed a delegation to call on the King to express their sympathy.

The delay in the reception of the Communes some days earlier had apparently been occasioned by difficulties of the ceremonial. The Third Estate did not wish to speak kneeling, though such had long been considered the custom. Bailly recounts this dramatically (*Mém.*, vol. 1, p. 104); the translation is from Arago.

"This custom," said M. de Barentin, "has existed from time immemorial, and if the King wished - - - "

"And if twenty-five millions of men do not wish it," exclaimed Bailly, interrupting the minister, "where are the means to force them?"

"The two privileged orders," replied the Guard of the Seals, somewhat stunned by the apostrophe, "no longer require the Third Estate to bend the knee; but, after having formerly possessed immense privileges in the ceremonial, they limit themselves now to asking some difference. This difference I cannot find."

"Do not take the trouble to seek for it," replied the President hastily; "however slight the difference might be, the Communes will not suffer it."

Thus did Bailly interpret the rising spirit of democracy in France.

During the memorable days from the 17th to the 23rd of June, Bailly presided over the Third Estate. On the 17th, the Deputies of the Communes, wearied from the changing principles of the other orders, determined in case of need to act without them, and adopted the title of National Assembly. On the 20th of June great excitement was fomented because the hall of the National Assembly was closed to the members without notice, ostensibly in preparation for a visit from the King two days later. At the suggestion of Guillotine, the Assembly moved to a tennis court. With five or six benches, and a table to write on, they stood all day, and took the famous oath "never to separate, but to assemble wherever circumstances might render it requisite, until the Constitution of the Kingdom should be established and confirmed on solid foundations."

When the King later addressed the Assembly, he ended his speech with the following imprudent remark. "I order you, Gentlemen, to separate immediately." The whole of the nobility and a portion of the clergy retired, while the Deputies of the Communes remained quietly in their places. The Grand Master of the Ceremonies having remarked it, approached Bailly saying, "You heard

the King's order, Sir?" The illustrious President answered, "I cannot adjourn the Assembly until it has deliberated on it." "Is that indeed your answer, and am I to communicate it to the King?" "Yes, Sir," replied Bailly, and immediately addressing the Deputies who surrounded him, he said, "It appears to me that the assembled nation cannot receive an order."

On July 2 Bailly quitted the chair of President of the National Assembly, and returned to his native Chaillot, where the residents feted him with fireworks and, in recognition of his achievements, made him honorary churchwarden. But he was destined not long to enjoy a pastoral existence. The Bastille was taken on the 14th of July. On the 15th the National Assembly received permission from the King to send a deputation to Paris to try to restore peace and order. Though Madame Bailly tried to persuade her husband to remain at home, he replied, "After a presidency that has been applauded, I am not sorry to show myself to my fellow-citizens."

The Assembly, having accomplished its purpose, was about to break up when, in a gesture of spontaneous enthusiasm, it proclaimed La Fayette Commander-in-Chief of the National Guard, (which had just been created) and Bailly Mayor of Paris. (*Mém.*, vol. 2, pp. 24-26.)

M. le marquis de La Fayette, accepting this honour with all signs of respect and recognition, drew his sword; he swore to sacrifice his life in the conservation of this liberty so precious, whose defence they had deigned to give him.

At the same instant everyone proclaimed M. Bailly provost of the guilds. One voice made itself heard saying: "Not provost of the guilds, but mayor of Paris." And by an acclamation, all those present repeated, "Yes, Mayor of Paris."

At this sudden, and apparently unexpected, tribute, Bailly was overcome with emotion, and his description of his reply may shed some comfort on those of us who, in moments of stress, find ourselves at a loss for words.

I know not whether I wept, I know not what I said; but I remember well that I was never so surprised, so confused, and so beneath myself. Surprise adding to my usual timidity before a large assembly, I rose, I stammered out a few words that were not heard, and that I did not hear myself, but which my agitation, much more than my mouth, rendered expressive. Another effect of my sudden stupidity was, that I accepted without knowing what a burden I was taking on myself.

This quotation, with its concluding sentence (so true still of people who accept heavy obligations) was written after Bailly had lived through many months of the heavy burden of the mayoralty. For when Bailly became Mayor, famine threatened the city. The supply of grain and flour in Paris would be exhausted in three days. The severe hail storm a year before, on July 13, 1788, had destroyed a large part of the harvest that year, and before the next harvest was ready the spectre of famine was stalking the streets of Paris. The day after Bailly became Mayor, all the overseers of the food administration in the city quietly disappeared, so that a hungry and infuriated populace could not punish them. On his second day as Mayor, Bailly's thoughts and energies had to turn immediately to the problem of getting flour and grain for the hungry. For some weeks it was a daily struggle to bring enough food into the city to satisfy the multitudes. Blunders of inefficient or stupid underlings frequently hampered the government's efforts to bring in wagon or barge loads of food for this hand-to-mouth existence. Bailly remarked later, "when I used to pass the bakers' shops during the scarcity, and saw them besieged by a crowd, my heart sunk within me; and even now that abundance has been restored to us, the sight of one of those shops strikes me with a deep emotion." The intense strain of this epoch appears to have undermined his health permanently.

Bailly was Mayor for two years and four months, during which time Paris was for the most part a peaceful city, by no means dripping with the blood that was later to be shed there. Bailly used his power in many good ways, such as an attempt to suppress the gambling houses. He refused to accept as part of his remuneration any funds which came from this source; actually he used a great deal of his own money in the duties of his office, and left it poorer than when he became Mayor. He also suppressed public exhibitions of animal fighting, and attempted reforms of prisons, especially urging that arrested persons be brought to trial more speedily. In such ways his outlook on life seems to have been well in advance of his century.

During the spring of 1791 as the populace became more restless, Bailly tried to pursue a sane and tolerant course. He attempted to moderate the demands of the mob, and opposed such men as

Marat and Hébert. By April 1791, however, his influence was beginning to wane, and two events of the early summer definitely destroyed his favour with the people. The first occurred on June 20-21 when the King and his family fled from the capital. Actually Bailly had taken measures to prevent such a flight, but the populace blamed both him and La Fayette for the King's escape, and for a few days both of them were in great danger.

It was, however, the disastrous events of the 17th of July which were probably eventually responsible for Bailly's execution. Early in July the National Assembly had discussed the idea of substituting a republic for a monarchy. Naturally this occasioned great fomentation on all sides. A petition was drawn up by the club of Jacobins, in favour of the republic, which was to be signed on the 17th of July on the Champ de Mars, on the altar of the country. The National Assembly considered this an anarchical movement, and on the 16th of July it ordered the city of Paris to use force if necessary to put down any rebellious movements. When the crowd was collected on the Champ de Mars for the signing of the petition on July 17th, it was reported that two good citizens had been killed, and a turmoil resulted. The Municipal Council ordered martial law proclaimed, and a red flag flown from the Hôtel de Ville. At six o'clock the National Guard, headed by La Fayette and Bailly, with the red flag and some cannon, began to march toward the altar. At this early period, the National Guard was a troublesome and insubordinate unit. At seven thirty this body arrived on the Champ de Mars, where they were met with heckling, stone throwing, and by the firing of a pistol. In the confusion the soldiers fired on the mob, as a result of which forty persons were killed and more than a hundred wounded. Order was then restored, but at a great price. Bailly was afterward held responsible for the order to fire, and this act cost him his popularity with the people.

Several points may be noted in Bailly's defense. He did not know that the gathering at the Champ de Mars was a relatively peaceful one; the reports of events which reached him were coloured and incorrect. He was not aware that the National Guard had loaded their muskets, and probably he gave no actual order to the Guard to fire. In the confusion, and later as the revolution itself gathered

momentum, it was very easy to make Bailly the scapegoat of the incident.

Bailly continued in the mayoralty for some months after this unfortunate day, but left it November 12, 1791, after installing his successor Pétion, and retired to Chaillot. His health was poor, however, and his physician urged him to undertake a journey for a change. The middle of June 1792 Bailly and his wife went to Nantes, where they took a small lodging with some congenial people. A pleasant existence was not long allowed him however. The Council of the Communes decreed that there was 6000 livres tax owing on the house and offices that he had occupied as Mayor, and that this tax must be paid immediately. To raise the funds Bailly had to sell all his excellent and treasured library at auction. The central government then began to treat him in the nature of a parolled criminal, and demanded that he report every eight days. He also received a letter from the Minister of the Interior informing him that the apartments in the Louvre which his family had occupied for over half a century had been taken from him. As Bailly had shortly before been obliged to sell his house at Chaillot, he was left with no home near Paris, the city where he had recently been first citizen. Small wonder it is that Bailly did not attempt any creative writing during this period, but contented himself with reading the latest novels as fast as the library received them. As Arago says, "Tranquillity of mind is not less requisite than vigour of intellect, to those who undertake great works."

(*To be concluded*)

REVIEW OF PUBLICATIONS

Skyshooting, (hunting the stars with your camera), by R. Newton Mayall and Margaret L. Mayall. xi + 172 pp. 6½ x 9¼ ins. New York, Ronald Press Company, 1949. Price $3.75.

This is a book which should encourage many amateur photographers or astronomers to try their hand at the hobby of taking pictures of the heavens. Mr. and Mrs. Mayall are already well-known for their popular book on the making and use of sundials. Mr. Mayall is an engineer by profession, with astronomy as a hobby. Mrs. Mayall has had a distinguished career at Harvard Observatory as Miss Cannon's assistant, and recently, her successor. They have both for many years been active in amateur astronomical societies. Thus by both experience and interests the authors are well able to write a book of instruction in this subject.

While for some fields of celestial photography the use of telescopes is explained, for a large number of the projects only ordinary cameras are required. In successive chapters various astronomical targets are discussed. The discussion in each case outlines the problem, and suggests the details of methods of procedure. Summaries at the end of most chapters list the required instrument (usually ordinary cameras or home-made box cameras); mounting (from a rigid support to a clock driven telescope); the aperture; plates or films; exposure time; and lists of suitable objects.

A fine feature of the book is the abundance of good illustrations. A number of these are working sketches of different items of equipment, but most of them are plates reproducing excellent photographs made by amateur astronomers. These range from the simplest star-trail photographs to the rarely surpassed photographs made by the Lowers, with their early home-made Schmidt-type telescopes.

This book is one of the Humanizing of Science series. "The Ways of the Weather," by W. J. Humphreys, and "Sunspots in Action," by Harlan T. Stetson, have already acquainted many amateur star-gazers with this series. "Skyshooting" is a worthy addition to the collection.

F. S. H.

Our Sun, by Donald H. Menzel Pp. viii+ 326, 6 x 8½ inches. Blakiston Company, Philadelphia and Toronto, 1949. Price $4.50.

The Harvard Books on Astronomy have well earned a favoured position on the shelves of amateur and professional astronomers alike. They represent comprehensive surveys of individual fields of astronomical knowledge. In addition to being written simply enough to be read with interest or even excitement, by serious amateurs, the books include good and generous collections of diagrams and photographs. The quality of the reproductions, typography, paper and binding are such as to make the use of the books a pleasure.

Dr. Menzel's contribution to the series, *Our Sun,* in every way fulfils expectation. The author's wide knowledge of the field of solar physics, his interest in solar-terrestrial relationships, and his personal experiences on many solar eclipse expeditions well qualify him to write a balanced summary of our present state of knowledge of the sun.

While in general astronomical research has been carried on as a pure science, a quest for knowledge for knowledge sake, many of the conclusions reached as a result of astrophysical studies have been of use in advancing pure and applied physics. In no astronomical field has this been more true than in solar physics. This is due to the closeness of the sun, which permits astronomers to study it in much more detail, and which causes the radiation of the sun to very profoundly affect aurorae, magnetism, radio transmission, climatic and meteorological conditions on the earth.

For these reasons any comprehensive book on solar physics provides a double appeal—the pleasure of exploring the sun itself, and the contemplation of the importance of solar conditions and their variations in the terms of present day and future environment on the earth. This new Harvard Book very successfully examines solar physics from this point of view.

About the first third of the book outlines the general methods of solar study. The next third deals more specifically with the variable features of the solar exterior—sunspots, prominences and the corona. The last three chapters deal with the solar interior, solar eclipses, and solar-terrestrial relationships.

While these books are not designed as text-books, their use by

students would be enhanced if references or a bibliography of selected readings in different topics could be included in later editions.

F. S. H.

Atomic Energy Levels, Volume I; by Charlotte E. Moore. Pages xliii+ 309; 11⅜ x 9 in.; cloth-bound. Circular of the National Bureau of Standards 467, issued June 15, 1949. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $2.75. (Remittances from foreign countries must be in U.S. exchange and must include an additional sum of one-third the publication price to cover the mailing costs).

Almost everyone who has worked in the field of atomic spectra either in the laboratory or with the stars will have had occasion to consult previous important compilations of spectroscopic data by Charlotte Moore (Mrs. B. W. Sitterly)—in particular her *Multiplet Table of Astrophysical Interest,* published in 1933. Now this author has published the first volume of a still more important compilation of data, namely, the atomic energy levels as derived from the analyses of optical spectra.

This first volume of the new compilation includes all the known data on the energy levels of elements of atomic number 1 (hydrogen) through 23 (vanadium). It includes not only the data on the neutral atoms but also on the singly, doubly, etc., ionized atoms. In the case of calcium, for example, the data extend to the fourteen-times-ionized atom.

The main tables are arranged in order of increasing atomic number, and under a given atomic number they are arranged in order of increasing stages of ionization. These tables list the electron configurations, the term designations, the J-values, the values of the energy levels and the term intervals. In addition, for each atom there is a short bibliography of the sources which were consulted. Also each list is dated with the month and year of completion so that the user may subsequently be able to recognize new data.

Additional tables give such information as Landé g-values, predicted terms of isoelectronic sequences, and lists of the elements.

While the book is essentially tabular, there are 12 pages of introductory material giving a brief review of the principles which govern

term analysis and designation, and explaining the notation. The author has gone to great pains to unify the notation, and in this lies one great value of her work. However, the greatest value lies in the collecting together in one place of all these important and much-used data. It is safe to predict that for decades to come well-thumbed copies of *Atomic Energy Levels* will be found on the desks of spectroscopists, astrophysicists, atomic physicists, chemists and many others.

J. F. H.

Our Wonderful Universe, by C. A. Chant. Revised edition. Pp. 280, 5 x 7½ inches. George G. Harrap, London, England, 1949. Clarke, Irwin and Co., Toronto. Price $2.25.

Our Wonderful Universe has, in the past twenty years, been so widely sold that a description of it is hardly necessary. The enlarged, revised edition which was published in 1940 rapidly sold out, and, due to British war-time publishing difficulties, there was much delay in bringing out this new printing.

In general scope *Our Wonderful Universe* combines a very simple but precise description of man's knowledge of the universe, and an explanation of some of the methods by which he obtains this knowledge. One of the charms of the book is the excellence of the two hundred drawings and photographs used as illustrations.

The universal appeal of the first edition of this book was evidenced by its republication in German, Polish and Czechoslovakian editions. Since then the revised edition has formed the basis of a Spanish edition, while a French edition is now being prepared in Quebec. English speaking astronomers and school teachers will be glad that *Our Wonderful Universe* is again obtainable in the English edition, for our young people and other beginners in astronomy.

F.S.H.

NOTES AND QUERIES

The Astronomer Royal Visits the United States

During his recent visit to the United States Sir Harold Spencer Jones received the Bruce Gold Medal of the Astronomical Society of the Pacific. He also inspected some of the recent remarkable developments in the astronomical field there, and at the meeting of the Royal Astronomical Society on May 13 gave an account of some things he had seen and learned. The following paragraphs are taken from the report of that meeting in *The Observatory* for June 1949.

After seventeen years it was most enjoyable to have the opportunity to spend three months in the United States visiting observatories and renewing acquaintance with old friends and meeting many younger astronomers who are now doing valuable work.

The highlight of the trip was the visit to Mount Palomar with Dr. Bowen to see the 200-inch telescope and the large Schmidt. A good idea of the size of the former can be conveyed by the fact that, at the dedication ceremony, a thousand people were comfortably seated under the dome of the telescope. This telescope is to be known as the Hale telescope after the great man of science Dr. George Ellery Hale, to whose vision and initiative in obtaining funds its construction is so largely due. The 200-inch telescope is extremely impressive, both by its great size and by its cleanness of design. There are no finding telescopes and no graduated circles. The performance of the oil pressure pad bearings is most interesting. The telescope, in fact, floats on a film of oil, and although it weighs about 350 tons it can be rotated by a motor of 1/12 h.p.

The outer zone of the large mirror was deliberately left a little high as it was expected that there might be some flexing of the outer edge, which could be corrected by local polishing. The flexibility of the mirror is extraordinary, and is similar to that of a 60-inch mirror of a thickness of only 1¼ inches. Consequently, the counterpoise system for the mirror has had to be very carefully designed, and one of the major tasks recently has been a reconstruction of the supports in order to redistribute the thrust taken by each. The mirror is of unequal stiffness, being stiffer at the inner and outer edges than intermediately.

A phantom telescope turns with the main telescope, and operates the dome motors. The whole operation of moving the telescope is easily performed; the required position is pre-set on a series of dials and, on pressing a button, the telescope turns to the correct position. The observer is carried

inside the telescope. A number of safety devices have been incorporated for automatic locking in case of danger. At present, observations are contemplated only at the Coudé and prime foci. A large number of Hartmann tests have been made with screens in different positions of the telescope and at different temperatures to decide how much must be removed from the high outer zone. The local polishing necessary will be done on Mount Palomar, and no great difficulty is expected to rise.

I had the opportunity of inspecting some of the photographs taken both with the full 200-inch capacity of the telescope and with the reduced 160-inch capacity. Dr. Hubble told me that he was extremely pleased with these as they indicated that the telescope will do all that had been hoped for, and will enable photographs to be taken of galaxies a thousand million light-years or more away.

* * * *

While I was in America Judge Hulbert wrote to inform me that the Trustees of the Tracy McGregor Fund had decided to give the 98-inch Pyrex glass in their possession to the Royal Observatory. This disc was cast by the Corning Glass Company in 1936 for a large reflector which has not been constructed. Tracy McGregor, who was very prominent in the city life of Detroit, was a friend of Judge Hulbert. Judge Hulbert, who has long taken a great interest in astronomy, has recently been elected a patron of the American Astronomical Society. Unfortunately, he has been very ill during the last few months, but it was possible for me to visit him. The generous gift of this disc should enable us to have the Isaac Newton telescope in operation two or three years earlier than would otherwise have been possible. Before leaving America I went to the British Joint Services Mission in Washington to arrange for the transport of this disc. The gift also includes a 26½-inch Pyrex secondary disc.

Our readers will wish to congratulate the Astronomer Royal on this handsome gift and will hope that the construction of the Isaac Newton telescope may proceed without undue delay.

C. A. C.

The Loon's Necklace

At the end of the regular dinner of the American Astronomical Society at its recent meeting in Ottawa there was shown a ten-minute colour-film entitled "The Loon's Necklace". This is a non-commercial film which has received international commendation. It was produced in Ottawa by Crawley Films Limited, the Editor and Director of which are, respectively, Mrs. and Mr. Crawley.

Reference was made to the Indian legend of how the loon ac-

quired the white bands around his neck, but it was very brief and some of those who were present may wish to have a fuller account of the film. Such is given in the *Imperial Oil Review* for August-September 1949, and is quoted below. The Imperial Oil Company purchased the Canadian rights for the film and presented them to the Canadian Educational Association.

The story concerns Kelora, a blind medicine man, who spends his days dreaming in the sun. He ignores his nagging wife and only the cry of the loon arouses him. One winter Kelora warns the people of his village that famine is about to strike but they laugh at him. Famine does strike, wolves raid the village and there is great sorrow. Kelora determines to save the village from further evil, and so he dons a *magic collar,* and armed with magic bow and arrows, he seeks out and destroys the wolves.

In the spring blind old Kelora goes in search of the loon, who, so the legend goes, is his father. Finding the loon, he begs for the restoration of his sight. The loon grants his wish and he is able to see, first dimly, then clearly; and Kelora, in gratitude, draws off the magic collar and gently tosses it to the loon. The collar encircles its neck while some white shells break from the cord and fall upon its black feathered back . . . and these markings you may see on the loon to-day.

In filming The Loon's Necklace a narrator tells the story as 35 actors, wearing carved wooden masks, enact the legend. The masks are more than a hundred years old and are still brilliant in their original pigments. They were loaned by the National Museum of Canada to the producers through arrangements made by Dr. Douglas Leechman, archaeologist of the anthropological division of the museum. Dr. Leechman suggested the story, based on his studies of the Indians of British Columbia.

"The story is familiar all up and down the North-western coast of the continent," said Dr. Leechman. "There are many legends as to how birds and animals acquired their distinguishing characteristics, not only in North American mythology but in that of the Old World as well.

"Indian children," Dr. Leechman said, "never tire of listening to these stories, although most of them have been repeated again and again. After all, Indian children are much like children anywhere; and just as our own kiddies ask for the story of Little Red Riding Hood, so did they ask their mothers or their grandmothers to tell the story of The Loon's Necklace, and always the beginning was the same: 'Many years ago there was an old blind medicine man, miserably poor'. . . ."

C. A. C.

Time Service Notes:—Earthquake observation by transit telescope

Unique in the history of the Time Service Division of the Dominion Observatory at Ottawa, was the observation of an earthquake with the broken-type Cooke transit.

Mr. J. P. Henderson was observing a time set late Sunday night, August 21, 1949. Conditions were excellent for transit observations.

At transit time of β Cephei (approximately 2325 hours E.S.T.), the level appeared to be unsteady, and the star wandered considerably in the field. When the level reading was made during transit, the bubble moved back and forth in an east-west direction with a period of about seven seconds. This oscillation was observed for about ten minutes and had an amplitude of two or three divisions. An earthquake was suspected, though no tremors could be felt.

Next morning both radio and press informed the world at large of an earthquake of major proportions. It had occurred in the Pacific Ocean just west of Prince Rupert and had been felt up and down the coast from Alaska to Seattle.

According to Mr. Milne of the Seismological Division, the earthquake was one of the largest on record for this year. Only a small amount of damage was reported from Prince Rupert and elsewhere because the epicentre was located out in the ocean rather than near some centre of population. At maximum the earth movement at Ottawa was of the order of forty microns, which is probably ten times or more greater than the earth movement indicated by the bubble excursions. The bubble represented a pendulum motion of about one-tenth of a second of arc. But the bubble might be considered as a highly damped sluggish indicator for such movements. The period of about seven seconds is in very good agreement with the seismic record.

Within half an hour the tremors subsided to the point where they were no longer perceptible either in bubble readings or in star movements. Seeing became steady again. The seismic record continued for some hours.

Dominion Observatory,
Ottawa,
August 31, 1949.

MEETINGS OF THE SOCIETY

AT WINNIPEG

October 13, 1948.—The regular meeting of the Winnipeg Centre of the Royal Astronomical Society was held on Wednesday evening, October 13th, in Theatre "B", University of Manitoba. Mr. L. T. S. Norris-Elye was in the chair. He expressed the severe loss this centre has suffered in the death of our president, Mr. L. W. Koser.

The speaker was Mr. H. Rasmussen, his subject "Optical Instruments." The lecture was illustrated with slides. Mr. Rasmussen began with a brief explanation of astronomical telescopes, showing the fundamentals of the Newtonian and Cassegrainian types and of the Schmidt camera. He continued by illustrating and explaining spectrometers and spectrophotometers, showing bright line spectra of luminous bodies and dark line spectra due to absorbing media. He explained the red shift in the spectra of bodies with high speeds of recession and the violet shift in spectra of advancing bodies, and how the red and violet shifts can be interpreted in terms of radial velocities. He showed the analogy between the red shift and the Doppler effect of sound waves.

Mr. Norris-Elye thanked the speaker for his excellent lecture which was enjoyed by a very small turnout.

December 8, 1948.—The Annual meeting of the Winnipeg Centre was held on Wednesday evening, December 8th in Theatre "B", University of Manitoba. Mr. H. E. Rasmussen, Vice-president, was in the chair.

The minutes of the last annual meeting and the minutes of the last executive meeting were read by the secretary, Miss B. Sharman. The treasurer's report showed a credit balance of $70.27. The treasurer pointed out that $45.00 which is our share of this year's dues will be forwarded to us from the general secretary.

Miss Sharman read the secretary's report. Seven regular meetings were held during the year, one observation night, and two executive meetings. The centre suffered a very severe loss during the year in the death of Mr. L. W. Koser.

Mr. Rasmussen read the nominations of officers as presented by the nominating committee. It was moved and seconded that nominations be closed. The officers elected for 1949 are listed elsewhere. Following election of officers a discussion of lecture topics for next year was held by members present. Among topics discussed the following were suggested:—Astral Navigation, Geology, Study of the Moon, Atomic Physics.

It was suggested that a short auxiliary paper on current astronomy be given at each meeting. Mr. V. C. Jones and Mr. L. T. S. Norris-Elye were asked to arrange for this feature. Two new members were proposed for membership.

Mr. H. C. Fairfield will be making a trip into U.S. and perhaps into South America and has volunteered to visit astronomical observatories and organiza-

tions on his tour and to bring back whatever interesting information is available to him. About 25 members were present. Meeting adjourned about 9:45 p.m,

A demonstration of ultra-violet light and its fluorescent effects on materials. also a demonstration of high frequency high voltage effects were given by H. E. Rasmussen following the meeting.

C. G. CARD, *Recorder.*

AT TORONTO

March 22, 1949.—The Chairman, Mr. A. R. Clute, President. The Secretary mentioned the possibility of having telescopes in city parks this summer, as well as on the campus, and called for volunteers who would bring and operate their own instruments.

One new member was elected: Dr. E. F. Kingston, 43 Elm Ave., Toronto 5.

The Chairman called upon Mr. Raymond E. Pearce, Director of the Toronto Centre Telescope Makers' Group, who spoke on the subject: "Telescopes—Their Why and How."

Mr. Pearce first emphasized the success his group has had in solving many problems for members who have been building their own telescopes, several of whom have now completed their instruments.

He then commenced his address by explaining the performance of the eye and how the telescope aids in clearer vision of distant objects, describing its first use for astronomical purposes by Galileo and the later developments of Kellner Huygens and Ramsden, leading up to the use of achromatic lenses. By means of slides, he showed some of the early types of telescopes.

Mr. Pearce described telescopes made by Sir William Herschel and the trouble he had in casting mirrors of speculum metal, which in later years were superseded by the silvered glass mirror, being much lighter in weight, and less subject to change in focus by temperature variations. His explanation of the methods of testing mirrors was very interesting. The speaker dealt very briefly with compound objective lenses stating that the high quality of glass required and the necessity of grinding and polishing several surfaces made objective lenses much more difficult than mirrors for the amateur to construct. For these reasons, the amateur usually confines his efforts to the manufacture of reflector type telescopes.

Mr. Pearce explained further the features and advantages of the different types of telescopes, their construction, the magnification possible, and other details, and the use of the spectroscope and photoelectric photometer. He then showed by slides some of the larger telescopes and pointed out the features he had mentioned.

Mr. David Gerrie explained several of the problems and difficulties he had experienced in grinding and polishing mirrors.

Following the meeting, there was a demonstration of the testing of mirrors, and several telescopes, both reflectors and refractors, were exhibited and inspected by the members.

April 5, 1949.—The Chairman, Mr. A. R. Clute, President

Two new members were elected:

Raymond R. Broadfoot, 617 Dupont St., Toronto.

Richard A. Graham, Downsview, Ont.

Mr. Clute introduced the speaker, Dr. Donald MacRae of the Warner and Swasey Observatory, Case Institute of Technology, Cleveland, Ohio, who addressed the meeting on the subject: "New Telescopes and the Milky Way."

In contrast to large telescopes, Dr. MacRae explained that useful astronomical work was being done in research investigations by medium size instruments with large aperture. Such telescopes are used for photography of smal areas about the size of the full moon, and should be equally effective for light of various colours. Refractors have slight colour errors whereas reflectors are not subject to these errors but the field of sharp focus is very narrow.

To combine the desirable features of refractors and reflectors—a wide field of sharp focus without colou r error— the Schmidt telescope, for photography, was developed twenty years ago by an optical worker, and is now a very important instrument in astronomical investigations. Its optical system consists of a (concave) spherical mirror preceded by a very specially figured thin lens known as a "correction plate", which compensates for the focussing error of such a mirror, this lens being placed at the centre of curvature of this mirror and being so thin and nearly flat that dispersion of light is very small and no serious colour errors are introduced. This telescope therefore is practically achromatic, has a very wide field of about 5 degrees and produces good images everywhere on a circular photographic plate or film. The foca lratio, *i.e.*, focal length to aperture diameter, is small, may be 3 to 5, and it is desirable that star images be small—1/1,000 of an inch in diameter or less. The photographic plate or film is slightly curved spherically, convex toward the mirror, with the centre of its curvature at the centre of curvature of this mirror.

By placing a thin four-degree prism in front of the lens, the spectra of the stars are obtained, their apparent diameters being so small that collimation is unnecessary. Where the spectra of two close stars may interfere, this prism is given a quarter turn, to direct the spectra at 90 degrees to its original position, and in many cases, this effects the desired separation.

Dr. MacRae explained the kind of problems for which the Schmidt telescope at the Warner and Swasey Observatory in Cleveland is being used, for study of stars at distances of 10^{15} miles, for search for opaque obstructive material between us and the stars and to study star clusters. At the present time, astronomers are attempting to make a census of stars in our galaxy in the neighborhood of the sun, and their positions relative to the sun, how far away each star is, and its intrinsic brightness, to determine the luminosity of the stars by their spectra and thus to measure the effect of absorption, to measure stellar proper motion, relation of our galaxy to distant galaxies, for finding faint galaxies, and to search for lost asteroids which were not followed or checked in posi.ion during the recent war.

The speaker showed slides to illustrate the design and principle of the Schmidt telescope-camera and some of the results obtained with it, and also exhibited some photographs of the congestion of stars in the Milky Way.

There was a brief discussion on the intepretation of spectra of stars which appear very close together, on the method of grinding and polishing the unique correction plate, and other points of interest in the lecture.

A vote of thanks to the speaker was moved by Dr. J. F. Heard.

April 12, 1949.—Miss Ruth Northcott gave an address on "Eclipses and Occultations."

The speaker explained the causes of solar and lunar eclipses and some of the difficulties encountered in predicting eclipses due to the inclination of the moon's orbit in relation to the plane of the earth's orbit. She pointed out that eclipses can occur only when the moon is at or near a node of its orbit and that as the nodes move gradually around the orbit in a period of approximately 19 years, the eclipse seasons advance each year.

The movements of the moon in relation to the earth and sun were demonstrated by means of a laboratory working model.

Miss Northcott described the visual phenomena of a lunar eclipse at different stages, suggesting that the partial phases, during which the edges of the shadow are slowly crossing the moon, are most interesting. She then showed the order of events in the different phases by means of a disc, representing the moon, passing into and through a circular dark shadow cast by the projector.

The speaker briefly explained occulations caused by the moon crossing in front of a star or planet, and made a few calculations regarding the coming occultation of Antares on April 16.

The Recorder showed his erecting star diagonal (90-degree) to the members present and explained its great advantage over the ordinary star diagonal in viewing lunar eclipses by giving the moon's image its proper orientation and having the shadow cross it in the proper direction. He also described the concentric colour bands to be seen in a lunar eclipse.

Following the meeting, several telescopes were set up and the initial phases of the total lunar eclipse on that evening were observed until a few minutes after totality commenced.

October 11, 1949.—This meeting was held at the David Dunlap Observatory, at Richmond Hill, at the invitation of the Director, Dr. F. S. Hogg. In the absence of Mr. Clute, Dr. Hogg, as vice-president, acted as chairman. Twenty-nine applicants for membership were nominated, as follows:

Mr. William P. Dobson, 62 Beatty Ave., Toronto.
Miss Loretta Dopfer, 81 Isabella St., Toronto.
Miss Ann E. Fair, 346 King St. West, Kingston.
Miss Marjorie Graham, 350 St. Clair Ave. W., Toronto.
Mr. A. F. Harris, 86 Hillcrest Drive, Toronto.
Mr. Fred E. Hetherington, K.C., 10 Adam St., St. Catharines.
Mr. William S. Hutton, 207 Old Orchard Grove, Toronto.
Mr. Bill B. Kammelman, 459 Shaw St., Toronto.
Miss Catherine Lund, 25 Sherwood Ave., Toronto.
Mr. Charles Raine, 222 Oakwood Ave., Toronto.
Mr. Michael C. Rooney, 294 Indian Rd. Cresc., Toronto.
Mr. Leo Zolkiewski, 1126 "R" Dovercourt Rd., Toronto.

Membership to commence with 1950—
Mrs. Evelyn M. Barker, 9 Pauline Ave., Toronto.
Mr. Samuel M. Blumenfeld, 11 Grosvenor St., Toronto.

Mrs. Edna Brooklyn, 18 Collahie St., Toronto.
Mr. Lorne A. Campbell, Ontario Research Foundation, 43 Queen's Park, Toronto.
Mrs. H. B. Cockburn, 149 Talbot Rd., Delhi.
Mr. Irwin H. Coulton, 197 Spadina Ave., Toronto.
Mr. Norman D. S. Duhig, 101 Westmount Ave., Lakeview.
Mr. Allan H. Elsey, 31 Bowden St., Toronto.
Miss June Green, 16 Hartford Ave., Toronto.
Mr. Herbert E. Griffith, 49 Beaconsfield Ave., Toronto.
Mr. Walter Johnson, 307 Manor Rd. E., Toronto.
Mr. C. Anthony Keith, 17 Wilgar Rd., Toronto.
Mr. Wilfrid S. Kennedy, 3 Elm Grove Ave., Toronto.
Mr. Mervyn Longhurst, 6 Kimberley Rd., Toronto.
Mr. George Pace, 79 Third St., Toronto.
Mrs. Alberta M. Peters, 87 Bellevue Ave., Toronto.
Mrs. E. F. Wells, 311 Lonsdale Rd., Toronto.

The Chairman then called upon Dr. C. A. Chant who assured the visitors that they were very welcome on their visit to the Observatory, and expressed special interest in these annual Fall meetings there. He recalled having joined the Society in 1892 and spoke of his early unsuccessful efforts to unite the Society with the University, particularly during his term as President, 1904-1907, but said he now believes it has been better for the Society that it has remained separate, for it has grown in its own individual way and has broadened its scope to a very encouraging degree.

The Chairman spoke of the studies being made at the Observatory with the photo-electric photometer and called upon Mr. R. L. Baglow of the staff to describe the work in more detail as applied to the stars. Mr. Baglow mentioned that the photo-electric effect had been discovered about eighty years ago by a German scientist, Hertz, who had noticed that spark discharges seemed to occur more readily in daylight than in darkness. He then explained photo-electric action and recent improvements to increase the current response by using a longer cell and introducing many anodes to cause movement of electrons from each anode to the next thus amplifying the current by a chain reaction or fission.

The speaker discussed two important applications of the photo-electric cell at the Observatory: (1) To study photographic plate spectra of stars. (2) To measure the brightness of stars, by comparison of one star with another, one important advantage of this cell for this purpose being its non-fatiguing characteristic whereby more reliable measurements can be obtained than by the eye, which is subject to fatigue during long observations.

The formal meeting was then adjourned and the members gathered around the 74-inch telescope which was described, in both its optical and mechanical features, by Dr. J. F. Heard. As it was a very rainy night, it was not possible to observe any celestial bodies through this instrument on this occasion. The photo-electric equipment used for measuring photographic spectra was demonstrated by Mr. W. Hossack, and resulting records of the oscillographic type were displayed.

Mr. Baglow showed the photo-cell attachment on the 19-inch telescope, and explained details of its operation and the method of adjusting the beam of light from a star, through stops of various diameters, to obtain the best results in measurement of star brightness.

Many new members were present, enjoying their first visit to the Observatory, and they showed keen interest in the information given by the speakers and in the explanations and demonstrations of equipment in use.

F. K. DALTON, *Recorder*.

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For many years the Toronto organization existed alone, but now the Society is national in extent, having active Centres in Montreal and Quebec, P.Q.; Ottawa, Toronto, Hamilton, Guelph, London, and Windsor, Ontario; Winnipeg, Man.; Saskatoon, Sask.; Edmonton, Alta.; Vancouver and Victoria, B.C. As well as nearly 1500 members of these Canadian centres, there are over 400 members not attached to any Centre, mostly resident in other nations, while some 160 additional institutions or persons subscribe to our publications.

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